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Effect of Slope Squat on Lower-Extremity Muscle Activity

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Introduction

- **Squat is a common multi-joint close-kinetic exercise used by clinicians and sport coaches to strengthen the lower-extremity (LE) muscles and enhance the posture and balance control of the lower limb (Ceaglio et al. 2010).**
- **During squat, cross-joint muscles (quadriceps, hamstrings, and gastrocnemius) contract to produce shear and compressive forces that may need to be controlled as part of a rehabilitation program. Excessive shear and compressive forces at the knee are the main risk factors for injuries during squatting (Escamila 2001).**
- **Squatting on a decline slope might reduce the load on the knee joint by reducing LE muscle activation compared to level squat. Therefore, this study aimed to explore the effects of a decline surface on LE muscle activity during double-leg squats in healthy subjects.**

Method

- **Fifteen participants (age 24.5 ± 3.2 years) performed five squats on both 5-degree slope and level ground.**
- **Surface electromyography (EMG) was recorded from three muscles of the dominant leg: rectus femoris, biceps femoris, and gastrocnemius.**
- **Participants were instructed to squat to a depth at which their thighs were parallel to the treadmill surface, which is around a 70-degree squat.**
- **A GoPro camera recorded the squat performance, and the peak knee joint angle (PKJA) was measured by Kinovea software.**

Results

- **There was no significant difference in PKJA between squats on a 5-degree slope and on level ground (70 ± 2.6° and 72 ± 4.6° respectively, P = 0.095), which laid a valid foundation for the muscle activation comparison.**
- **The comparison of muscle activity at PKJA between 0-degree and 5-degree squat is presented as table and graph below (Table 1, Figure 1).**
- **For biceps femoris, muscle activity at PKJA was significantly lower on 5-degree slope than on level ground (54 ± 36.4 µV and 60 ± 32.9 µV respectively, P = 0.016).**
- **For rectus femoris and gastrocnemius, there was no significant difference in muscle activity at PKJA (P = 0.15 and P = 0.074 respectively).**

	Condition	Mean peak RMS EMG (µV)	Standard deviation peak RMS EMG (µV)
Rectus femoris	0-degree	169	60.6
	5-degree	157	62.7
Biceps femoris	0-degree	60	32.9
	5-degree	54	36.4
Gastrocnemius	0-degree	25	11.8
	5-degree	29	16.2

Table 1. Descriptive statistics of EMG data

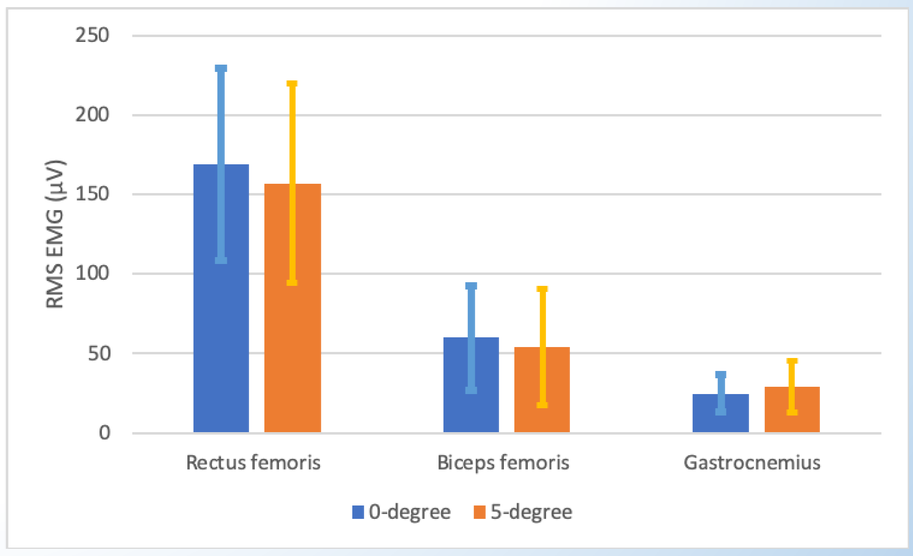

Figure 1. Comparison of muscle activity across conditions. Error bars represent standard deviation .

Discussion & Conclusions

- **The activity of biceps femoris at PKJA was less when a squat was performed on a 5-degree decline than on level ground.**
- **In clinical rehabilitation, patients with knee injury who have LE muscle weakness may benefit from performing squats on a decline surface, because slope squat requires less hamstring muscle activity at PKJA.**

References

1. Ceaglio, S. et al. 2010. Muscular activity during dynamic squats in patients with ACL reconstruction. *Conf Proc IEEE Eng Med Biol Soc* 2010, pp. 3950-3953.

2. Escamilla, R. F. 2001. Knee biomechanics of the dynamic squat exercise. *Medicine & science in sports & exercise* 33(1), pp. 127-141.